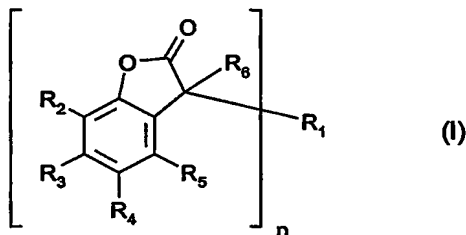


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WHAT IS CLAIMED IS:

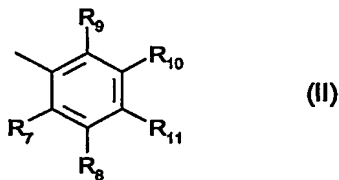
1. A composition of matter normally subject to oxidative deterioration comprising an edible organic substance normally subject to oxidative deterioration and a minor amount effective as an antioxidant of one or more compounds selected from the group consisting of

(i) 3-arylbenzofuranones in the present invention are compounds of the formula I



in which, if n is 1,

R₁ is unsubstituted or C₁-C₄alkyl-, C₁-C₄alkoxy-, C₁-C₄alkylthio-, hydroxyl-, halo-, amino-, C₁-C₄alkylamino-, phenylamino- or di(C₁-C₄alkyl)amino-substituted naphthyl, phenanthryl, anthryl, 5,6,7,8-tetrahydro-2-naphthyl, 5,6,7,8-tetrahydro-1-naphthyl, thienyl, benzo[b]thienyl, naphtho[2,3-b]thienyl, thianthrenyl, dibenzofuryl, chromenyl, xanthenyl, phenoxathiinyl, pyrrolyl, imidazolyl, pyrazolyl, pyrazinyl, pyrimidinyl, pyridazinyl, indolizynyl, isoindolyl, indolyl, indazolyl, purinyl, quinolizynyl, isoquinolyl, quinolyl, phthalazinyl, naphthyridinyl, quinoxalinyl, quinazolinyl, cinnolynyl, pteridinyl, carbazolyl, β-carbolinyl, phenanthridinyl, acridinyl, perimidinyl, phenanthrolinyl, phenazinyl, isothiazolyl, phenothiazinyl, isoxazolyl, furazanyl, biphenyl, terphenyl, fluorenyl or phenoxazinyl, or R₁ is a radical of the formula II



and

if n is 2,

R₁ is unsubstituted or C₁-C₄alkyl- or hydroxy-substituted phenylene or naphthylene; or is -R₁₂-X-R₁₃-,

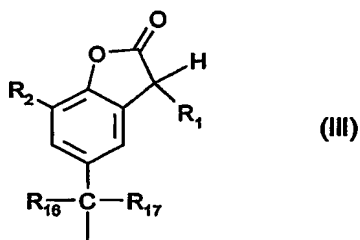
R₂, R₃, R₄ and R₅ independently of one another are hydrogen, chlorine, hydroxyl, C₁-C₂₅alkyl, C₇-C₉phenylalkyl, unsubstituted or C₁-C₄alkyl-substituted phenyl; unsubstituted or C₁-C₄alkyl-substituted C₅-C₈cycloalkyl; C₁-C₁₈alkoxy, C₁-C₁₈alkylthio, C₁-C₄alkylamino, di(C₁-

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C₄alkyl)amino, C₁-C₂₅alkanoyloxy, C₁-C₂₅alkanoylamino, C₃-C₂₅alkenoyloxy,

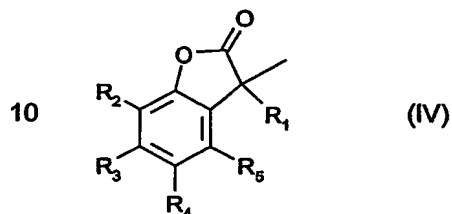
C₃-C₂₅alkanoyloxy which is interrupted by oxygen, sulfur or >N-R_{14} ; C₆-C₈cycloalkyl-

carbonyloxy, benzoyloxy or C₁-C₁₂alkyl-substituted benzoyloxy; or else the radicals R₂ and R₃ or the radicals R₃ and R₄ or the radicals R₄ and R₅, together with the carbon atoms to which they are attached, form a benzo ring, R₄ is additionally -(CH₂)_p-COR₁₅ or -(CH₂)_qOH or, if R₃, R₅ and R₆ are hydrogen, R₄ is additionally a radical of the formula III



in which R₁ is defined as indicated above for n = 1,

R₆ is hydrogen or a radical of the formula IV



where R₄ is not a radical of the formula III and R₁ is defined as indicated above for n = 1,

R₇, R₈, R₉, R₁₀ and R₁₁ independently of one another are hydrogen, halogen, hydroxyl,

C₁-C₂₅alkyl, C₂-C₂₅alkyl interrupted by oxygen, sulfur or >N-R_{14} ; C₁-C₂₅alkoxy,

C₂-C₂₅alkoxy interrupted by oxygen, sulfur or >N-R_{14} ; C₁-C₂₅alkylthio, C₃-C₂₅alkenyl, C₃-

C₂₅alkenyloxy, C₃-C₂₅alkynyl, C₃-C₂₅alkynyloxy, C₇-C₉phenylalkyl, C₇-C₉phenylalkoxy, unsubstituted or C₁-C₄alkyl-substituted phenyl; unsubstituted or C₁-C₄alkyl-substituted phenoxy; unsubstituted or C₁-C₄alkyl-substituted C₅-C₈cycloalkyl; unsubstituted or C₁-C₄alkyl-substituted C₅-C₈cycloalkoxy; C₁-C₄alkylamino, di(C₁-C₄alkyl)amino, C₁-C₂₅alkanoyl, C₃-

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C₂₅alkanoyl interrupted by oxygen, sulfur or >N-R_{14} ; C₁-C₂₅alkanoyloxy, C₃-

C₂₅alkanoyloxy interrupted by oxygen, sulfur or >N-R_{14} ; C₁-C₂₅alkanoylamino, C₃-

C₂₅alkenoyl, C₃-C₂₅alkenoyl interrupted by oxygen, sulfur or >N-R_{14} ; C₃-C₂₅alkenoyloxy,

C₃-C₂₅alkenoyloxy interrupted by oxygen, sulfur or >N-R_{14} ; C₆-C₉cycloalkylcarbonyl, C₆-

5 C₉cycloalkylcarbonyloxy, benzoyl or C₁-C₁₂alkyl-substituted benzoyl; benzoyloxy or C₁-

C₁₂alkyl-substituted benzoyloxy; $\text{—O—}\overset{\overset{\text{R}_{18}}{|}}{\underset{\underset{\text{R}_{19}}{|}}{\text{C}}}\text{—}\overset{\overset{\text{O}}{||}}{\text{C}}\text{—R}_{15}$ or $\text{—O—}\overset{\overset{\text{R}_{20}}{|}}{\underset{\underset{\text{H}}{|}}{\text{C}}}\text{—}\overset{\overset{\text{R}_{21}}{|}}{\underset{\underset{\text{R}_{22}}{|}}{\text{C}}}\text{—O—R}_{23}$, or

else, in formula II, the radicals R₇ and R₈ or the radicals R₈ and R₁₁, together with the carbon atoms to which they are attached, form a benzo ring,

R₁₂ and R₁₃ independently of one another are unsubstituted or C₁-C₄alkyl-substituted

10 phenylene or naphthylene,

R₁₄ is hydrogen or C₁-C₈alkyl,

R₁₅ is hydroxyl, $\left[\text{—O}^- \frac{1}{r} \text{M}^{r+}\right]$, C₁-C₁₈alkoxy or $\text{—N}\begin{matrix} \text{R}_{24} \\ \text{R}_{25} \end{matrix}$,

R₁₆ and R₁₇ independently of one another are hydrogen, CF₃, C₁-C₁₂alkyl or phenyl, or R₁₆ and R₁₇, together with the C atom to which they are attached, form a C₅-C₈cycloalkylidene

15 ring which is unsubstituted or substituted from 1 to 3 times by C₁-C₄alkyl;

R₁₈ and R₁₉ independently of one another are hydrogen, C₁-C₄alkyl or phenyl,

R₂₀ is hydrogen or C₁-C₄alkyl,

R₂₁ is hydrogen, unsubstituted or C₁-C₄alkyl-substituted phenyl; C₁-C₂₅alkyl, C₂-C₂₅alkyl

interrupted by oxygen, sulfur or >N-R_{14} ; C₇-C₉phenylalkyl which is unsubstituted or

20 substituted on the phenyl radical from 1 to 3 times by C₁-C₄alkyl; C₇-C₂₅phenylalkyl which is unsubstituted or substituted on the phenyl radical from 1 to 3 times by C₁-C₄alkyl and

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interrupted by oxygen, sulfur or $\text{N}-\text{R}_{14}$, or else the radicals R_{20} and R_{21} , together with

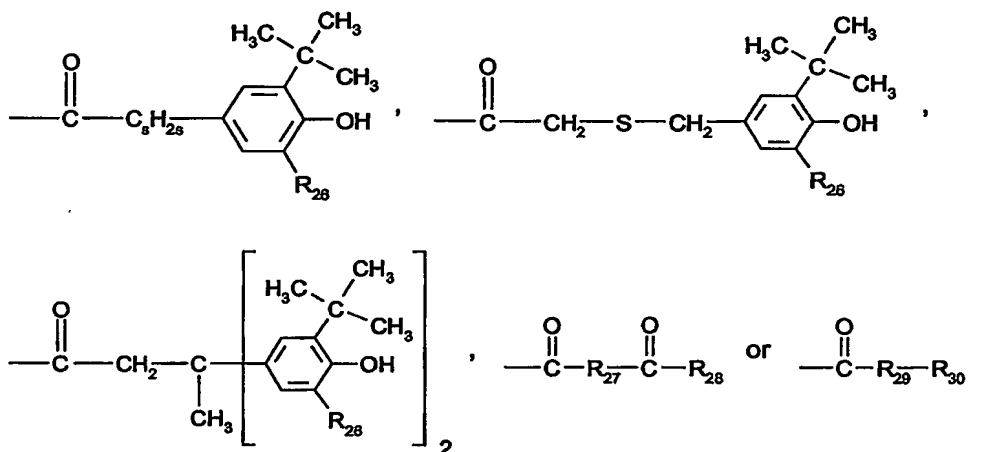
the carbon atoms to which they are attached, form a $\text{C}_5\text{-C}_{12}$ cycloalkylene ring which is unsubstituted or substituted from 1 to 3 times by $\text{C}_1\text{-C}_4$ alkyl;

R_{22} is hydrogen or $\text{C}_1\text{-C}_4$ alkyl,

5 R_{23} is hydrogen, $\text{C}_1\text{-C}_{25}$ alkanoyl, $\text{C}_3\text{-C}_{25}$ alkenoyl, $\text{C}_3\text{-C}_{25}$ alkanoyl interrupted by oxygen, sulfur

or $\text{N}-\text{R}_{14}$; $\text{C}_2\text{-C}_{25}$ alkanoyl substituted by a di($\text{C}_1\text{-C}_6$ alkyl)phosphonate group;

$\text{C}_6\text{-C}_9$ cycloalkylcarbonyl, thenoyl, furoyl, benzoyl or $\text{C}_1\text{-C}_{12}$ alkyl-substituted benzoyl;



10 R_{24} and R_{25} independently of one another are hydrogen or $\text{C}_1\text{-C}_{18}$ alkyl,

R_{26} is hydrogen or $\text{C}_1\text{-C}_8$ alkyl,

R_{27} is a direct bond, $\text{C}_1\text{-C}_{18}$ alkylene, $\text{C}_2\text{-C}_{18}$ alkylene interrupted by oxygen, sulfur or

$\text{N}-\text{R}_{14}$; $\text{C}_2\text{-C}_{18}$ alkenylene, $\text{C}_2\text{-C}_{20}$ alkylidene, $\text{C}_7\text{-C}_{20}$ phenylalkylidene,

$\text{C}_5\text{-C}_8$ cycloalkylene, $\text{C}_7\text{-C}_8$ bicycloalkylene, unsubstituted or $\text{C}_1\text{-C}_4$ alkyl-substituted phenylene,

15 or or ,

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R_{28} is hydroxyl, $\left[-O^- \frac{1}{r} M^{r+} \right]$, C₁-C₁₈alkoxy or $-N \begin{matrix} R_{24} \\ R_{25} \end{matrix}$,

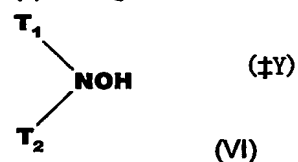
R_{29} is oxygen, -NH- or $\begin{matrix} \diagup \\ N \end{matrix} - \overset{O}{\parallel} C - NH - R_{30}$,

R_{30} is C₁-C₁₈alkyl or phenyl,

R_{31} is hydrogen or C₁-C₁₈alkyl,

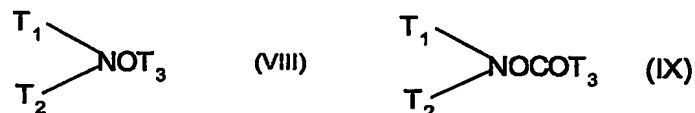
- 5 M is an r-valent metal cation,
 X is a direct bond, oxygen, sulfur or -NR₃₁-,
 n is 1 or 2,
 p is 0, 1 or 2,
 q is 1, 2, 3, 4, 5 or 6,
 10 r is 1, 2 or 3, and
 s is 0, 1 or 2;

(ii) a long chain N,N-dialkylhydroxylamine of formula (VI)



- 15 wherein T₁ and T₂ are independently straight or branched chain alkyl of 6 to 36 carbon atoms;

(iii) substituted hydroxylamines may be for example of the formula (VIII) or (IX)



- 20 wherein

T₁ is straight or branched chain alkyl of 1 to 36 carbon atoms, cycloalkyl of 5 to 12 carbon atoms, aralkyl of 7 to 9 carbon atoms, or said aralkyl substituted by one or two alkyl of 1 to 12 carbon atoms or by one or two halogen atoms;

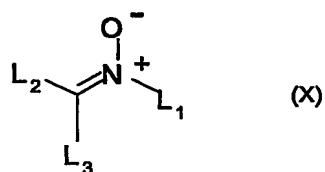
T₂ is hydrogen, or independently has the same meaning as T₁; and

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T₃ is allyl, straight or branched chain alkyl of 1 to 36 carbon atoms, cycloalkyl of 5 to 18 carbon atoms, cycloalkenyl of 5 to 18 carbon atoms or a straight or branched chain alkyl of 1 to 4 carbon atoms substituted by phenyl or by phenyl substituted by one or two alkyl groups of 1 to 4 carbon atoms or by 1 or 2 halogen atoms;

5

(iv) nitrones of the formula (X)



wherein

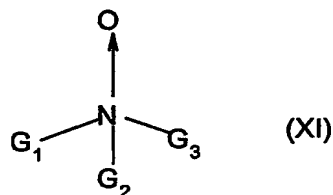
10 L₁ is straight or branched chain alkyl of 1 to 36 carbon atoms, cycloalkyl of 5 to 12 carbon atoms, aralkyl of 7 to 9 carbon atoms, or said aralkyl substituted by one or two alkyl of 1 to 12 carbon atoms or by one or two halogen atoms;

L₂ and L₃ are independently hydrogen, straight or branched chain alkyl of 1 to 36 carbon atoms, cycloalkyl of 5 to 12 carbon atoms, aralkyl of 7 to 9 carbon atoms, or said aralkyl substituted by one or two alkyl of 1 to 12 carbon atoms or by one or two halogen atoms;

15

or L₁ and L₂ together form a five- or six-membered ring including the nitrogen atom; and

20 (v) amine oxides are for example saturated tertiary amine oxides as represented by general formula (XI):



wherein

25 G₁ and G₂ are independently a straight or branched chain alkyl of 6 to 36 carbon atoms, aryl of 6 to 12 carbon atoms, aralkyl of 7 to 36 carbon atoms, alkaryl of 7 to 36 carbon atoms, cycloalkyl of 5 to 36 carbon atoms, alkylcycloalkyl of 6 to 36 carbon atoms or cycloalkylalkyl of 6 to 36 carbon atoms;

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G₃ is a straight or branched chain alkyl of 1 to 36 carbon atoms, aryl of 6 to 12 carbon atoms, aralkyl of 7 to 36 carbon atoms, alkaryl of 7 to 36 carbon atoms, cycloalkyl of 5 to 36 carbon atoms, alkylcycloalkyl of 6 to 36 carbon atoms or cycloalkylalkyl of 6 to 36 carbon atoms; with the proviso that at least one of G₁, G₂ and G₃ contains a b carbon-

5 hydrogen bond; and

wherein said aryl groups may be substituted by one to three halogen, alkyl of 1 to 8 carbon atoms, alkoxy of 1 to 8 carbon atoms or combinations thereof; and

wherein said alkyl, aralkyl, alkaryl, cycloalkyl, alkylcycloalkyl and cycloalkylalkyl groups may be interrupted by one to sixteen -O-, -S-, -SO-, -SO₂-, -COO-, -OCO-, -CO-, -
 10 NG₄-, -CONG₄- and -NG₄CO- groups, or wherein said alkyl, aralkyl, alkaryl, cycloalkyl, alkylcycloalkyl and cycloalkylalkyl groups may be substituted by one to sixteen groups selected from -OG₄, -SG₄, -COOG₄, -OCOG₄, -COG₄, -N(G₄)₂, -CON(G₄)₂, -NG₄COG₄ and 5- and 6-membered rings containing the -C(CH₃)(CH₂R_x)NL(CH₂R_x)(CH₃)C- group or wherein said alkyl, aralkyl, alkaryl, cycloalkyl, alkylcycloalkyl and cycloalkylalkyl groups are both
 15 interrupted and substituted by the groups mentioned above; and

wherein

G₄ is independently hydrogen or alkyl of 1 to 8 carbon atoms;

R_x is hydrogen or methyl;

L is hydrogen, hydroxy, C₁₋₃₀ straight or branched chain alkyl moiety, a -C(O)R
 20 moiety where R is a C₁₋₃₀ straight or branched chain alkyl group, or a -OR_y moiety; and
 R_y is C₁₋₃₀ straight or branched chain alkyl, C₂-C₃₀ alkenyl, C₂-C₃₀ alkynyl, C₅-C₁₂ cycloalkyl, C₆-C₁₀ bicycloalkyl, C₅-C₈ cycloalkenyl, C₆-C₁₀ aryl, C₇-C₉ aralkyl, C₇-C₉ aralkyl substituted by alkyl or aryl, or -CO(D), where D is C₁-C₁₈ alkyl, C₁-C₁₈ alkoxy, phenyl, phenyl substituted by hydroxy, alkyl or alkoxy, or amino or amino mono- or di-substituted by alkyl or
 25 phenyl.

2. The composition of claim 1 wherein the benzofuranone is at least one compound of formula I wherein n = 1, R₁ is phenyl which is unsubstituted or substituted in para-position by C₁-C₁₈alkylthio or di(C₁-C₄alkyl)amino; mono- to penta-substituted alkyphenyl containing
 30 together a total of at most 18 carbon atoms in the 1 to 5 alkyl substituents; naphthyl, biphenyl, terphenyl, phenanthryl, anthryl, fluorenyl, carbazolyl, thienyl, pyrrolyl, phenothizinyll or 5,6,7,8-tetrahydronaphthyl, each of which is unsubstituted or substituted by C₁-C₄alkyl, C₁-C₄alkoxy, C₁-C₄alkylthio, hydroxy or amino.

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3. The composition of claim 1 wherein the benzofuranone is a compound of formula I wherein n is 2, R₁ is -R₁₂-X-R₁₃-, R₁₂ and R₁₃ are phenylene, X is oxygen or -NR₃₁-, and R₃₁ is C₁-C₄alkyl.

5 4. The composition of claim 1 wherein the benzofuranone is at least one compound selected from the group consisting of 3-[4-(2-acetoxyethoxy)phenyl]-5,7-di-tert-butyl-benzofuran-2-one; 5,7-di-tert-butyl-3-[4-(2-stearoyloxyethoxy)phenyl]benzofuran-2-one; 3,3'-bis[5,7-di-tert-butyl-3-(4-[2-hydroxyethoxy]phenyl)benzofuran-2-one]; 5,7-di-tert-butyl-3-(4-ethoxyphenyl)benzofuran-2-one; 3-(4-acetoxy-3,5-dimethylphenyl)-5,7-di-tert-butylben-
10 zofuran-2-one; 3-(3,5-dimethyl-4-pivaloyloxy-phenyl)-5,7-di-tert-butyl-benzofuran-2-one; 5,7-di-tert-butyl-3-phenylbenzofuran-2-one; 5,7-di-tert-butyl-3-(3,4-dimethylphenyl)-benzofuran-2-one; 5,7-di-tert-butyl-3-(2,3-dimethylphenyl)benzofuran-2-one.

15 5. The compositions of claim 1 wherein the long chain hydroxylamine is a compound of the formula (VI) wherein T₁ and T₂ are independently selected from a straight or branched chain alkyl of 12-36 carbon atoms.

20 6. The composition of claim 1 wherein the long chain hydroxylamine is a compound of the formula (VI) wherein T₁ and T₂ are independently selected from a straight or branched chain alkyl of 16-18 carbon atoms.

25 7. The composition of claim 1 wherein the long chain hydroxylamine is a compound of formula (VI) wherein T₁ and T₂ are the same and are a straight chain alkyl of 18 carbon atoms.

 8. The composition of claim 1 wherein the substituted hydroxylamine is at least one compound selected from O-allyl-N,N-dioctadecylhydroxylamine and O-n-propyl-N,N-dioctadecylhydroxylamine or N,N-di(hydrogenated tallow)acetoxamine.

30 9. The composition of claim 1 wherein the nitron is at least one compound selected from the group consisting of N-benzyl- α -phenylnitron, N-ethyl- α -methylnitron, N-octyl- α -heptylnitron, N-lauryl- α -undecylnitron, N-tetradecyl- α -tridcylnitron, N-hexadecyl- α -pentadecylnitron, N-octadecyl- α -heptadecylnitron, N-hexadecyl- α -heptadecylnitron, N-octadecyl- α -pentadecylnitron, N-heptadecyl- α -heptadecylnitron, N-octadecyl- α -

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hexadecylnitrone, N-methyl- α -heptadecylnitrone and the nitrone derived from N,N-di(hydrogenated tallow)hydroxylamine.

10. The composition of claim 1 wherein the amine oxide is a trialkyl amine oxide.

11. The composition of claim 1 wherein the amine oxide is tri(C₁₂-C₁₄) amine oxide.

12. The composition of claim 1 wherein the amine oxide is di(C₁₂-C₁₄) methyl amine oxide.

13. The composition of claim 1 wherein the amine oxide is tri(C₁₆-C₁₈) amine oxide.

14. The composition of claim 1 wherein the antioxidant is present in an amount of from about 0.005% by weight to about 5% by weight, based on the weight of the edible organic substance.

15. The composition of claim 1 wherein the antioxidant is present in an amount of from about 0.01% by weight to about 1% by weight, based on the weight of the edible organic substance.

16. The composition of claim 1 wherein the composition further comprises additional food additives selected from food antioxidants in addition to those specified in claim 1, emulsifiers, suspension agent and colorings.

17. The composition of claim 1 wherein the composition further comprises food antioxidants selected from the group consisting of butylated hydroxytoluene, butylated hydroxyanisole, tocopherol, ascorbic acid, benzylphosphonates, esters of b-(3,5-di-tert-butyl-4-hydroxyphenyl)propionic acid with mono- or polyhydric alcohols, esters of b-(5-tert-butyl-4-hydroxy-3-methylphenyl)propionic acid with mono- or polyhydric alcohols, esters of b-(3,5-dicyclohexyl-4-hydroxyphenyl)propionic acid with mono- or polyhydric alcohols, esters of 3,5-di-tert-butyl-4-hydroxyphenyl acetic acid with mono- or polyhydric alcohols, phosphites and phosphonites.

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18. The composition of claim 1 wherein the antioxidant is one or more compounds selected from the group consisting of

i.) an N,N-di(alkyl)hydroxylamine produced by the direct oxidation of N,N-di(hydrogenated tallow)amine,

5 ii.) O-allyl-N,N-dioctadecylhydroxylamine,

iii.) N-octadecyl-a-heptadecylnitrone, and

iv.) a di(C₁₆-C₁₈)alkyl methyl amine oxide.

19. The composition of claim 1 wherein the edible organic substance is a food
10 containing fatty acid glycerides, edible fats and fatty oils.

20. The composition of claim 1 wherein the edible organic substance is a pet food or animal feed.

15